

**ISOLATION OF CELLULOSE NANOCRYSTAL FROM
OIL PALM BIOMASS WITH DIFFERENT
FORMIC ACID HYDROLYSIS TIME**

AHMAD AFIQ BIN JUMHURI

**Final Year Project Report Submitted In
Partial Fulfillment of the Requirements for the
Degree of Bachelor of Science (Hons.) Chemistry
in the Faculty of Applied Sciences
University Teknologi MARA**

JULY 2017

This Final Year Project Report entitled “**Isolation of Cellulose Nanocrystal from Oil Palm Biomass with Different Formic Acid Hydrolysis Time**” was submitted by Ahmad Afiq bin Jumhuri, in partial fulfilment of the requirements for the Degree of Bachelor of Science (Hons.) Chemistry, in the Faculty of Applied Sciences, and was approved by



Ahmad Husaini Mohamed
Supervisor
B. Sc. (Hons.) Chemistry
Faculty of Applied Sciences
Universiti Teknologi MARA
72000 Kuala Pilah
Negeri Sembilan



Nurul Huda Abdul Halim
Project Coordinator
B. Sc. (Hons.) Chemistry
Faculty of Applied Sciences
Universiti Teknologi MARA
72000 Kuala Pilah
Negeri Sembilan



Mazni Musa
Head of Programme
B. Sc. (Hons.) Chemistry
Faculty of Applied Sciences
Universiti Teknologi MARA
72000 Kuala Pilah
Negeri Sembilan

Date: 7 / 8 / 2017

TABLE OF CONTENTS

ACKNOWLEDGEMENT	Page iii
TABLE OF CONTENTS	iv
LIST OF TABLES	vi
LIST OF FIGURES	vii
LIST OF ABBREVIATIONS	viii
ABSTRACT	ix
ABSTRAK	x
CHAPTER 1 INTRODUCTION	1
1.1 Background of study	1
1.1.1 Nanocellulose	1
1.1.2 Isolation of cellulose nanocrystal	3
1.1.3 Oil palm biomass	4
1.2 Problem statement	7
1.3 Significance of study	8
1.4 Objective of study	9
CHAPTER 2 LITERATURE REVIEW	10
2.1 Cellulose nanocrystal	10
2.2 Acid hydrolysis of biomass to isolate cellulose nanocrystal	13
CHAPTER 3 METHODOLOGY	17
3.1 Materials	17
3.2.1 Raw material	17
3.2.2 Chemical	17
3.2 Methods	17
3.2.1 Sample preparation	17
3.2.2 Pretreatment	18
3.2.3 Formic acid hydrolysis with different hydrolysis time	18
3.3 Characterization	19
3.3.1 Spectroscopy study by Fourier transform infrared (FTIR)	19
3.3.2 Field emission scanning electron microscopy analysis	19
3.3.3 X-Ray diffraction analysis	19

CHAPTER 4 RESULTS AND DISCUSSION	21
4.1 Isolation of cellulose nanocrystal	21
4.2 Characterisation	23
4.2.1 FTIR spectroscopic analysis	23
4.2.2 Crystallinity index from XRD	28
4.2.3 Morphology of isolated CNC	32
 CHAPTER 5 CONCLUSION AND RECOMMENDATION	 36
 CITED REFERENCES	 38
APPENDICES	41
<i>CURRICULUM VITAE</i>	48

ABSTRACT

ISOLATION OF CELLULOSE NANOCRYSTAL FROM OIL PALM BIOMASS WITH DIFFERENT FORMIC ACID HYDROLYSIS TIME

Oil palm biomass is a renewable resource that can be manipulated for many applications. Nanocellulose which can be extracted from oil palm biomass is renewable and biodegradable with wide range of possible applications. Cellulose nanocrystal (CNC) was isolated using formic acid hydrolysis with different hydrolysis time from oil palm biomass in the forms of oil palm mesocarp (OPM) and oil palm empty fruit bunch (OPEFB). CNCs isolated from both type of biomass were characterized using Fourier transform infrared (FTIR), X-Ray diffraction (XRD) and field emission scanning electron microscope (FESEM). Percentage yield of cellulose nanocrystals from OPEFB and OPM were around the same range of 28 -41% showing the effect of hydrolysis time. FTIR analysis show peaks of lignin and hemicellulose at peaks 1200cm^{-1} and 1700cm^{-1} were completely removed after pretreatment process. XRD spectrum show the difference in crystal properties of the isolated CNC. CNC isolated from OPEFB show higher crystallinity index (60%) compared to that of OPM (55%). The morphology studies using FESEM show that CNC isolated from OPEFB to be globular while CNC from OPM show needle-like structure. Nanocellulose in the form of CNCs were successfully isolated from the study.